THE ENGINEER.

The British Industries Fair at Birmingham.

The British Industries Fair.

In this Supplement, together with its two-page plate, we continue the account of the exhibits at the Birmingham Section of the British Industries Fair, which we started in the Supplement accompanying our issue of February 14th.

Crossley Brothers, Ltd.

This year Crossley Brothers, Ltd., of Openshaw, Manchester, have confined their principal exhibits to the vertical type of compressorless oil engine recently placed on the market. The four-cylinder, 220 B.H.P. engine, which is shown in operation, is illustrated in Fig. VII. of to-day's Plate Supplement. The bore of the cylinder is 12in. and the stroke 16in., the normal working speed being 350 r.p.m. The engine is designed to utilise any non-asphaltic fuel which comes within the British Engineering Standards Specifications A and B.

As our illustration shows, all the working parts are enclosed. The top casing of the engine, which covers the cam shaft operating levers, is fitted with aluminium sliding covers which permit of immediate access to the cam shaft, valve gear and oil sprayers. The crank case and end unit are furnished with detachable inspection doors, which can easily be removed to give free access to the internal parts.

The base plate which carries the crank shaft is of the girder pattern, and it is machined on the under side to fit on to an auxiliary base plate when desired. An oil channel is cast round the outside of the engine frame in order to collect any oil which may accumulate during the cleaning of the engine. The engine framing, or centre section, consists of a heavy cast iron casing of box section, the lower portion of which forms the upper part of the crank case and the upper portion the water jacket for the cylinders. The design adopted enables the cylinders to be firmly secured in one rigid housing. Detachable doors are provided for access to the crank shaft and connecting-rod bearings, and there are also cleaning doors for the removal of sediment from the water jackets. Each cylinder liner is a plain parallel casting, the top portion of which is spigotted and nested into the frame of the engine without the aid of bolts. The lower portion of the liner is left to expand and contract in a joint fitted with rubber rings.

The crank shaft is 7¼in. in diameter and each main bearing is 7in. in length, the long bearing at the fly-wheel end being 9¾in. long. The crank pins are 7¼in. diameter by 7in. in length, and the hollow gudgeon pin, which is hardened, is 5in. in diameter with a length of 5¾in. All the main bearings are adjustable and consist of bronze shells lined with white metal, while the top end bush is made in hard phosphor bronze. The cylinder head forms a separate casting, which is of the fold plate type, giving a simple arrangement of valves and accessible valve gear. Each of the valves is housed in a separate casing, which can be quickly removed for examination. Ground trunk-type pistons are employed and the heads are strengthened by internal ribs. The fuel pumps, as our illustration shows, are arranged at the end of the engine opposite the fly-wheel. There is a separate plunger for each cylinder and governing is effected by the opening of a spill valve. Means are provided for balancing the amount of oil delivered by each pump, and each can be cut out by a trip lever. The governor is made entirely from steel and is designed for a speed adjustment of 5 per cent. above and below normal speed, with hand adjustment. From full load to no load the speed variation above or below mean speed is 7 per cent. temporarily and 3 per cent. permanently.

The fuel pump is gear driven from the crank shaft and the timing of the pumps can be altered either separately or collectively. Speed strainers are fitted in the fuel supply pipe to the atomisers, which are of the differential spring-loaded type.

The cam shaft is driven by a silent chain which runs over an idler wheel and is capable of adjustment. The shaft extends across the tops of the cylinders, but along one side and is totally enclosed. Steel cams on the shaft operate the inlet and exhaust valve levers direct.

Lubrication of the engine bearings, cams, levers, &c., is by pressure. The circulation of the oil is maintained by means of an eccentrically operated pump unit in duplicate arranged in an accessible position on the end housing. The crank case is of the dry type, in which the oil, after passing through the bearings, is drained away into a sump fitted with a filter, through which all the oil passes. An Autoklean oil strainer is also provided.

Starting of the engine from cold is effected by compressed air and for this purpose each cylinder is fitted with a separate air service, comprising a positively timed air valve operated from the cam shaft and further controlled by a single hand lever, which, on its first movement, relieves the compression in the engine cylinders. On the second movement compressed air is admitted to the cylinders, thus starting up the engine. On the third movement of the lever, the engine is placed under full compression and the air pressure service is shut off. The engine then continues to ignite each fuel charge under the control of the governor.

The second engine, which is also shown in operation, is of the three-cylinder vertical compressorless type. It has a normal rating of 82 brake horse-power at 450 r.p.m., and is shown complete with extension shaft and belt pulley, as arranged for industrial driving. Suitable compressed air starting equipment, consisting of a direct-coupled petrol engine and compressor with a receiver, is also shown.

Fig. 1—Petrol-Electric Runabout Crane—Morris

Herbert Morris, Ltd.

A peculiar little runabout crane is being exhibited by Herbert Morris, Ltd., of Loughborough, and its lower part is illustrated in Fig. 1.

The mechanism of this crane is driven on the petrol-electric system, and the jib and hoisting gear are of normal design, but the wheel arrangement of the undercarriage is quite unusual. There are three wheels, one at the back and two in front, and all of them are mounted on vertical pivots so that they are steerable. The two front wheels are the drivers for travelling, as they carry a weight dependent upon the load on the hook. The result of this completely steerable wheel arrangement is that the crane can travel in any direction with respect to the orientation of its frame and jib, it can rotate on its own centre and can also circle round its load, characteristics which should prove very useful in crowded stock yards. It is made in three sizes for from 9 cwt. to 35 cwt. lift, with a maximum radius of about 14ft. to 18ft.

National Gas Engine Company.

The exhibits of the National Gas Engine Company include engines operating on gas, heavy oil, paraffin, and petrol. The largest engine shown is of the horizontal twin-cylinder type, with the bed *en bloc* and the fly-wheel fitted on the outside. This engine, which has a bore of 11in. and a stroke of 19in., is designed to develop 84 maximum and 76 constant brake horse-power, when running at 250 revolutions per minute. It is arranged to start immediately from cold by means of compressed air, and to run on various classes of fuel oils. One advantage claimed by the makers for this type of engine is that the fuel is injected into the combustion chambers by direct mechanical means through atomisers of special construction, so that neither compressed air nor complicated spring mechanism is required for the injection process. A single cylinder heavy-oil engine, developing 22 constant brake horse-power at a normal speed of 275 revolutions per minute is shown. The cylinder has a bore of 9in. with a stroke of 17in. It is fitted with hot tube and lamp starting. A still smaller single-cylinder engine of a similar type to that just mentioned is also shown, which is designed to develop 11 brake horse-power at constant load when running at 350 revolutions per minute. As shown by Fig. I. in our Plate Supplement, it is furnished with a heavy fly-wheel for driving a dynamo through a "Texrope." The engine is of the four-stroke type, and is started by means of a tube heated by a lamp. It is of very simple design, all the working parts being easy of access. Particular attention has been devoted to the design of the breech end, and the valves and valve gears. Atomisation of the fuel is effected by the combination of fuel pressure and a sprayer. A grooved pulley on the crank shaft drives by means of a "Texrope" an E.C.C. dynamo, designed to give 60–40 ampères at 100–150 volts. The electrical output of the set is 7 kilowatts and the space occupied is small, being 7ft. 10in. in length by 4ft. 4in. in breadth, with a height of 5ft. 6in. The National totally enclosed horizontal F type petrol-paraffin engine has been referred to in our columns. It is specially suitable for farms, estates, sawing, small lighting sets, or for driving small compressors and pumps. It operates on the four-stroke principle, and is of the horizontal single-cylinder type, with a totally enclosed crank case. It is rated at 2½ brake horse-power on petrol or paraffin, and its weight is about 3 cwt. The engine operates either with thermo-syphonic cooling with a separate water tank, or with a hopper mounted directly on the cylinder, which suffices for cooling when the engine is required for intermittent working. The hopper is a separate casting bolted to the cylinder, and can be replaced by a cover for connecting to a water tank. Thus at any time the system of cooling can be altered without difficulty. Ignition is effected by a special high-tension magneto, and the governor

is fitted on one end of the crank shaft. All the working parts are lubricated automatically, so that there is little likelihood of injury to the wearing parts by lack of attention. The carburetter is simple in form and if it be desired to run the engine on paraffin, it is only necessary to start it up on petrol and after running for a few minutes to turn a two-way cock, after which it will continue to operate on the paraffin fuel.

THE BRITISH THOMSON-HOUSTON COMPANY.

Many of the British Thomson-Houston Company's exhibits are shown in operation, particularly motors and control gear for industrial service. The motors shown include fractional horse-power

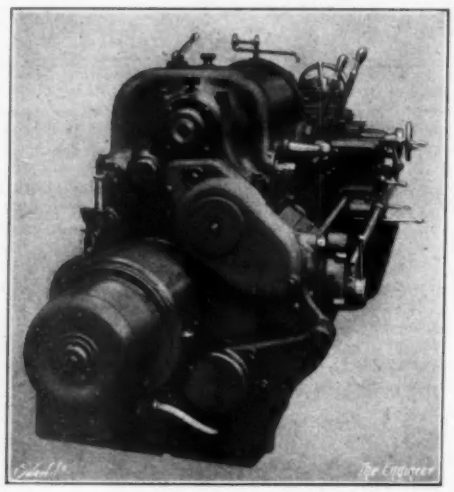


FIG. 2—MOTOR ON DEAN, SMITH & GRACE LATHE—B.T.H.

machines, and machines of larger outputs. Examples of the company's "built-in" motors and worm-geared motor units are also on view. For use on single-phase circuits the company is exhibiting a repulsion induction motor designed to start under heavy load, and to run at a high power factor at a constant speed. Other industrial exhibits consist of motor generators and "Fabroil" pinions. The company's built-in motors for giving a direct drive to machine tools and wood-working machinery must prove of interest to machine tool and wood-working machinery manufacturers. The stator consists of a unit comprising a core and windings in an enclosing shell, whilst the revolving unit comprises

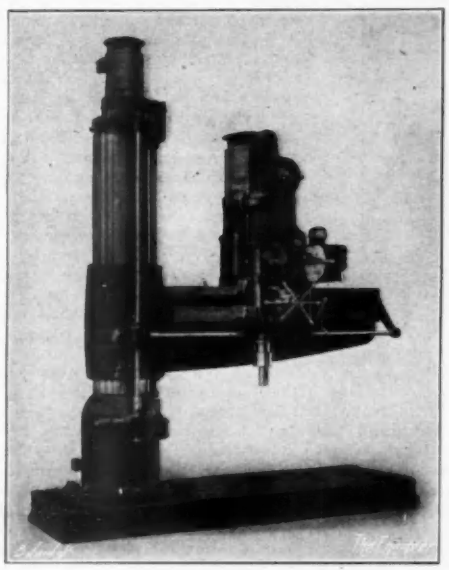


FIG. 3—SWIFT DRILL WITH MOTOR—B.T.H.

a squirrel-cage rotor with centrifugally cast aluminium bars and end rings. The units are assembled by the machine tool makers in frames which are designed as an integral part of the machine tool, the machine tool makers providing the shaft, end shields, and bearings as part of their design. For certain machine tools, B.T.H. vertical spindle motors can be used as horizontal end shield mounted machines, the end shield at the driving end being bolted to a vertical surface, so that the motor is overhung with the shaft horizontal. Fig. 2 shows a Dean, Smith and Grace lathe equipped with a B.T.H. overhung direct-current motor bolted to the base of the machine. A small auxiliary motor similarly mounted is provided for traversing the saddle. Fig. 3 shows a Swift radial drilling machine fitted with B.T.H. vertical-spindle motors, and hand-operated control gear.

A new range of worm-geared motor units is exhibited. These units, with the motor mounted integrally with a worm reducing gear, are made in two forms—vertical and horizontal, as shown in Figs. 4 and 5. The vertical arrangement is preferable where sufficient head room is available,

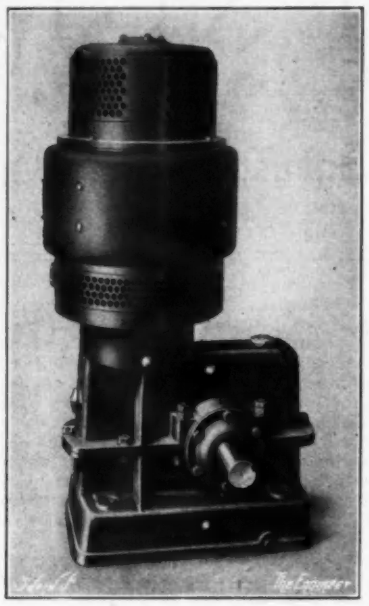


FIG. 4—WORM GEAR MOTOR UNIT—B.T.H.

but where head room is limited, the horizontal unit may be employed. Permanent accuracy of alignment, together with minimum weight and space is achieved by these equipments, and the elimination of a motor

FIG. 5—WORM GEAR MOTOR UNIT—B.T.H.

bed-plate avoids a frequent cause of trouble, owing to the bed-plate springing.

Various motor starters and controllers for alternating-current and direct-current reversing and non-

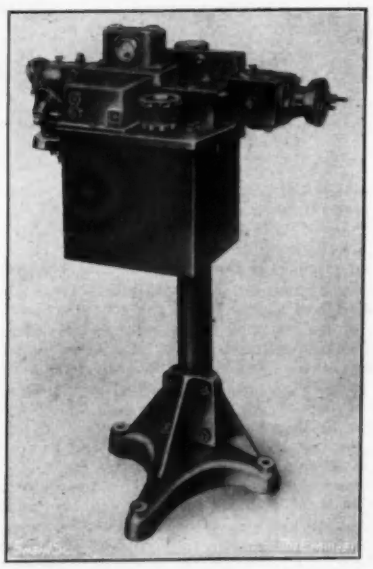


FIG. 6—A.C. MOTOR CONTROL PANEL—B.T.H.

reversing motors are shown. An improved form of oil-immersed alternating-current control panel, as shown in Fig. 6, is exhibited for the first time. It is designed for starting and protecting three-phase slip-ring induction motors, with capacities up to 15–20 horse-power at any voltage up to 550 at 25 and 40–50 cycles, and is suitable for a maximum stator current of 30 ampères—including the standard B.E.S.A. overloads—and rotor current not exceeding 75 ampères. It is suitable for starting three-phase induction motors against full-load torque twice per hour. Over-current and under-voltage features are incorporated and the connections are such that the motor may be stopped at a distance by means of a push button.

The company's thermal type, oil-immersed motor starter and circuit breaker, which is shown in operation, has been developed for the direct starting of squirrel-cage motors taking current up to 30 ampères on voltages up to 660, and for giving protection against every kind of fault on all phases. This starter

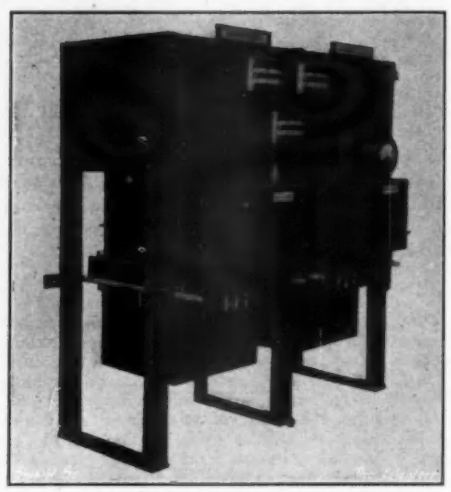


FIG. 7—METAL-CLAD SWITCHGEAR, FRONT—B.T.H.

is 8¾in. high, 7¾in. deep by 6in. wide. It has a dust and drip-proof enclosure, and is under push-botton control. A typical totally enclosed alternating-current pillar type contactor starting equipment, suitable for controlling a non-reversing 25 H.P. slip-ring induction motor against twice full-load torque, with remote push-button control, is also exhibited. The pillar embodies no-volt release, overload protection on all three phases, and a self-contained triple pole isolator, as well as the usual contactors, notching relays and starting resistances.

The company's metal-clad "Z" class, vertical plugging switchgear, as shown in Figs. 7 and 8, are on view. This gear, which has been designed for service under the most adverse climatic and other conditions, has bus-bars completely shut off from the

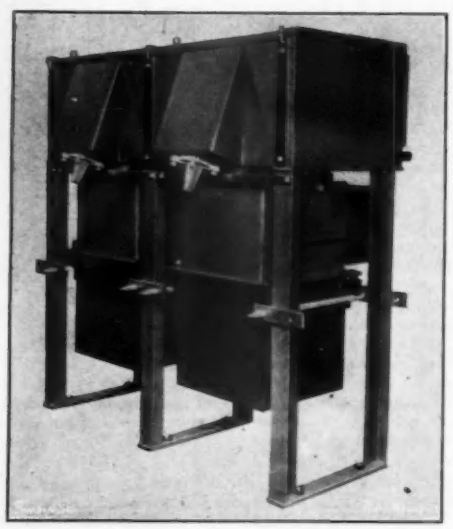


FIG. 8—METAL-CLAD SWITCHGEAR, BACK—B.T.H.

other chambers, and oil circuit breakers plugged into contact socket holes and removable by displacing the breakers vertically downwards—a scheme which results in substantial economies in space compared with the draw-out truck type switchgear. For a complete switchboard only one simple lifting carriage is required. Guide holes are provided in the frame to accommodate locating spears carried by the oil circuit breaker, thus ensuring that the breaker is lifted into position in correct alignment. A shutter closes the contact socket holes when the breaker is withdrawn.

FIELDING AND PLATT, LTD.

Two examples of the firm's latest type of low-pressure cold-starting oil engine are exhibited on the stand of Fielding and Platt, Ltd., of Atlas Works, Gloucester. We show in Fig. VI. of our Plate Supplement the

larger engine, which has a maximum output of 60 B.H.P. and a working output of 55 B.H.P. The cylinder bore is 12½in. with a stroke of 22in., and the normal running speed is 240 r.p.m. The second engine is slightly smaller, its normal maximum output being 50 B.H.P., or 45 B.H.P. working load at 250 r.p.m., with a cylinder bore of 11in. and a 20in. stroke. As will be seen from Fig. VI., the main bed-plate and cylinder jacket is a one-piece casting, which also serves to house the crank shaft bearings. The side

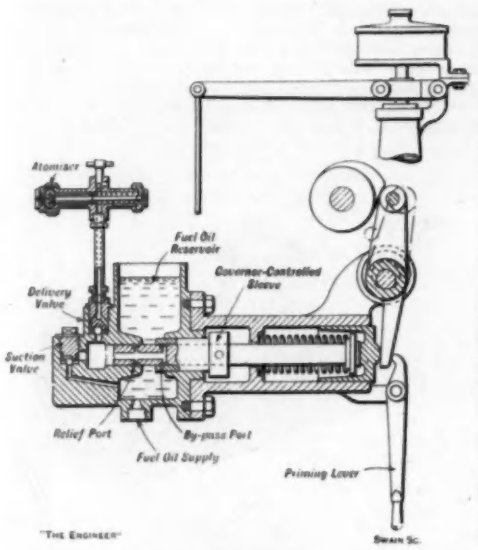


FIG. 9—FUEL PUMP—FIELDING AND PLATT

shaft driving the valves is of the usual spiral gear-driven type. A special feature is the patented design of combustion chamber, which is water cooled. It comprises two separate parts, which are inter-connected by means of a specially shaped port. Although at starting use is made of an auxiliary fuel spray in the forward chamber, the main atomiser is placed in the first or outer chamber, so that initial combustion takes place well away from the valves, thereby increasing the life of the valve seatings. The interconnecting port referred to is so designed that a high degree of turbulence is obtained with very complete combustion and corresponding fuel economy. The maximum pressure in the cylinder is low and does not exceed 425 lb. to 430 lb. per square inch. In the range of engines from 12 to 240 B.H.P. fuel consumptions of 0·46 to 0·42, according to the size of engine, are obtained.

An interesting feature of the engine is the airless injection of the fuel and the fuel pumps, a diagrammatic section of which is shown in Fig. 9. From the drawing given it will be seen that the fuel pump plunger is hollow and that it is furnished with two sets of ports, which are drilled from the outside of the plunger through to the centre space. At the outer end of the plunger there is a sliding sleeve, the position of which is directly controlled by the governor. Assuming that the suction stroke of the plunger has been completed and the inward delivery stroke is now taking place, it will be seen that until the plunger has attained a high speed at the centre part of its stroke the fuel oil is by-passed through the plunger and the relief port. When this port is covered the oil is delivered through the valve to the atomiser, and the pressure is maintained until it is suddenly released by the opening of the by-pass port as it emerges from the governor-controlled sleeve. By this means a sharp cut-off is obtained with no dribble from the atomiser. The movement of the sleeve is effected by a slotted quadrant lever which engages with a pin fixed in the side of the sleeve, and is actuated by the governor. A very simple form of atomiser is used with a comparatively large orifice, and a non-return valve is provided. The atomiser is so designed that it can be quickly dismantled for inspection if desired, but in practice it has been found, we are informed, that engines will continue running for several months in constant operation without requiring any attention. Starting is effected by a supply of compressed air stored in a steel reservoir, which is charged from the engine through an automatic charging valve. The setting of the main and auxiliary atomisers for starting and running is rendered very simple by clearly marked indications of the starting and running positions. In order to set the cams for the automatic starting and compression release valves a small hand wheel is provided on the side shaft near to the cams, on which the starting and running positions are marked. All important parts are furnished with pressure lubrication, which is derived from a mechanical lubricator fixed at the centre of the engine and worked from the side shaft. As our drawings, Figs. 10 and 13, show, large water jackets are provided, and inspection doors are fitted. There is no water space at the joint between the lever and the cylinder head casting.

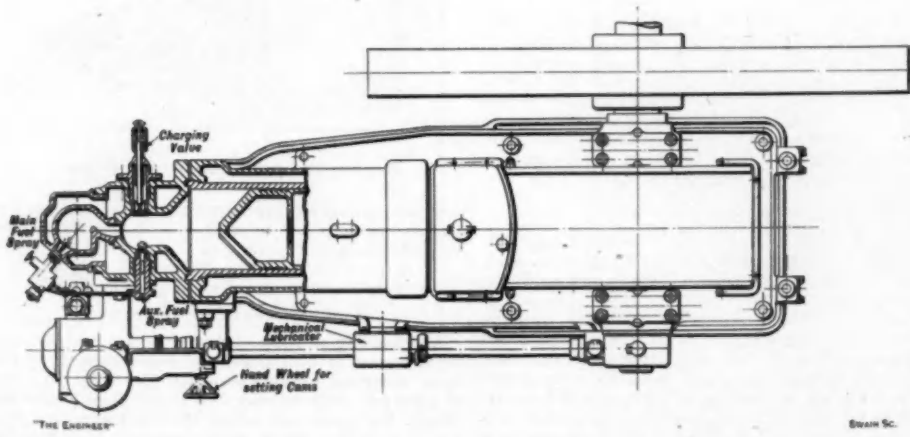


FIG. 10—45 B.H.P. OIL ENGINE—FIELDING AND PLATT

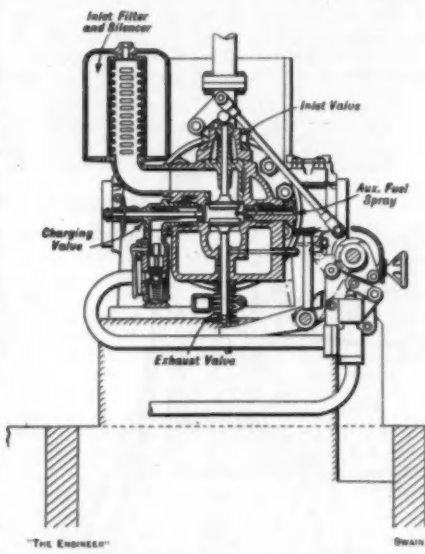
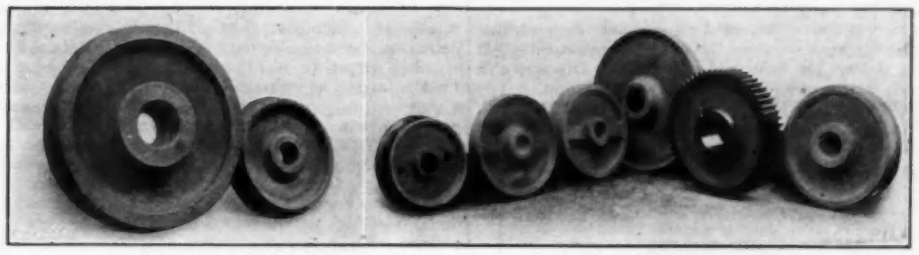


FIG. 13—OIL ENGINE—FIELDING AND PLATT



FIGS. 11 AND 12—DROP STAMPINGS—POWELL BRETT

POWELL BRETT, LTD.

The Powell Brett Company, of Midland Works, Coventry, in conjunction with the Drop Forgers' Association, is showing a number of stampings, and from among them we illustrate, in Figs. 11 and 12, some large examples. As will be seen, these specimens are mostly blanks for steel gear wheels, and that one shown with the teeth cut is said to be the heaviest drop forging produced in this country. It is for the driving gear of an electric locomotive and many of the same size have been made. Its diameter is 31½in. and it weighs 9 cwt. before machining. The general proportions may be gauged by comparison with the small drop-forged railway wheel shown alongside the blank in Fig. 11.

J. AND F. HOWARD, LTD.

Three quite distinct classes of exhibits are shown on the stand of J. and F. Howard, of Bedford. They comprise two small petrol locomotives, some road-making equipment and abattoir fittings. The locomotives shown are two of the smallest sizes made by this firm, and are of 2 and 3 tons respectively. That shown in Fig. 14 is the largest size, and weighs 12 tons. While the larger sizes provide an economical means of speeding up shunting on main line sidings, the purpose of these smaller machines, for 24in. gauge, is for internal transport in works, use on constructional contracts, in quarries, &c. The power unit is a four-cylinder petrol engine, developing 20–28 B.H.P. in the 2-ton size and 25–36 B.H.P. in the 3-ton. The drive is taken by machine-cut, case-hardened, spur and bevel gearing, running in oil, in a two-speed gear-box and by roller chain to the front axle, and thence again by roller chain to the rear axle, giving a four-wheel drive. The driver is provided with a comfortable seat and has a clear view to the front and rear. His controls are conveniently grouped before him, and require very little skill in

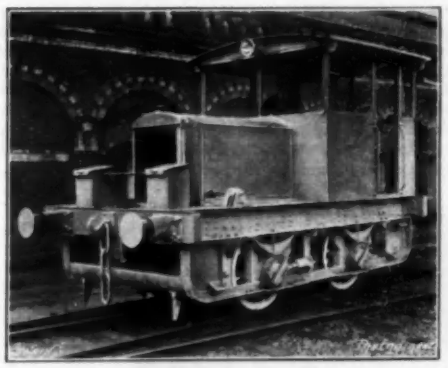


FIG. 14—PETROL LOCOMOTIVE—HOWARD

operation. A clutch stop facilities gear changing, and the gears are so arranged that it is impossible for the most clumsy driver to cause damage. A two-speed gear-box is shown as a separate exhibit, and illustrates the simplicty of control. Ball bearings are fitted throughout the gear-box, which forms an oil bath for the gears. As another separate exhibit, a roller bearing axle-box is shown. Besides the roller bearings which reduce friction, and therefore petrol consumption, these axle-boxes are provided with an excentric adjusting device, which enables the chain tension to be quickly and accurately adjusted. The effective draw-bar pull of the smallest engine is 1200 lb. in the low gear, that of the 3-ton size 1800 lb., and in the case of the big engine 6300 lb. The 12-ton size is equipped with a Dorman six-cylinder engine, and has spiral bevel gear in the transmission, with a three-speed gear-box. It is also provided with an electric lighting and starting equipment.

There are two road-making exhibits on this stand. One is a 6ft. road grader for cutting, shaping, and maintaining earth and gravel roads. The frame is arched and is mounted on the three-point suspension principle, enabling the road wheels to follow every irregularity of the surface without distortion to any part. The pull from the draw-bar is taken through the centre pin of a turntable direct to the blade, thus removing all stress from the frame. The blade is adjustable for height and angle, and it can be turned completely round and used to smooth the road surface. The other road implement is a heavy pattern rooter scarifier.

PETTERS LTD.

A noteworthy exhibit on the stand of Petters Ltd., of Westland Works, Yeovil, is the three-cylinder 195 B.H.P. cold-starting, airless-injection oil engine,

illustrated by Fig. IV. of our Plate Supplement, in which the engine is seen on test in the makers' works. It has a cylinder bore of 12½in. with a stroke of 18½in., and is designed to develop its full output of 195 B.H.P. at 275 r.p.m. At the last Birmingham Fair the first single-cylinder unit of the then new "Atomic Diesel" type was exhibited, and a full description of that engine is to be found in our issue of February 15th, 1929. The present unit is the largest of the "Atomic" series of engines yet exhibited, and visitors have an opportunity of seeing the engine in actual operation. The series of engines in this class includes models with one to four cylinders with designed outputs from 25 to 260 B.H.P. In Fig. 17 we show a vertical section through the 65

Fig. 15—Jointing Ring—Petter

B.H.P. per cylinder engine. Attention may be called to the deep bed-plate whi h has an extension to carry the fuel pumps and governor, along with the mechanically operated sight-feed lubricator. The engine works with a dry bed-plate, and means are provided to run off the oil after a certain level has been exceeded, which oil, after filtration, is available for further use. The crank shaft is balanced, and large main bearings are provided which are furnished with special sealing rings, making them free from the effects of crank case compression and suction. On the top of the bed-plate there is bolted the crank case with its side air inlet valves. The cylinder jackets and liners are water cooled and are provided with large inspection doors, and the top of the crank case is bored out to receive

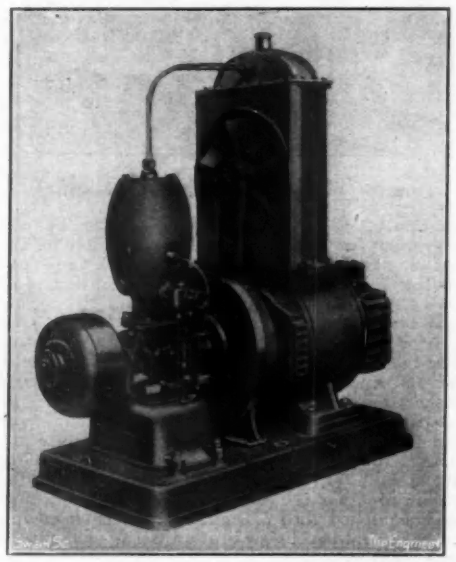


Fig. 16—Lighting Set—Petter

them. As the drawing indicates, a two-piece cylinder head is employed, which construction gives easy access to all water spaces. The combustion chamber is of a simple conical form with a centrally placed atomiser, and the head of the piston is bevelled at the sides to conform to the cylinder head. The crown of the piston is well supported by internal ribs, and the head carries five piston rings with a single oil scraping ring at the lower end of the skirt. The gudgeon pin is hollow and its ends are closed by spring-controlled wipers, the purpose of which is to pick up the oil from the top end bearing. This bearing is of the Hyatt roller pattern. The fuel pumps are controlled by the governor, and a speed control hand wheel is fitted which enables the engine to be run at a wide range of speeds. Automatic air-starting is provided in two cylinders, the hand-operated starting valve shown in Fig. 17 only being employed in the smaller sizes of engine. Tests made on the "Atomic Diesel" type of engine show, we understand, a brake thermal efficiency of 32 per cent., and good and economical combustion has been obtained with a large range of oil fuels.

A smaller engine unit also shown in operation is the 950-watt Auto-Petter-Light plant, illustrated in Fig. 16, which comprises a 2 B.H.P. single-cylinder petrol engine with a bore of 2½in. and a stroke of 3in., coupled direct to a 110-volt generator running at 1000 r.p.m. The exhibit is of unusual interest, since a new and improved type of controller and starting gear is shown. A standard type of self-starter with a "Bendix" drive is fitted to the engine, and with the exception of a 12-volt starting battery no storage battery is required. The speed of the unit is controlled by a centrifugal governor which regulates the amount of fuel supplied to the engine. The principal feature of the new controller consists in the large gauge windings employed and a new type of magnetic contact with interlocking and self-cleaning contacts.

Assuming the set to be shut down, the downward movement of any control switch actuates an electro-magnet on the controller, which puts the starting motor into operation and removes the magneto earthing by which the engine was brought to rest. As soon as regular ignition takes place the windings of the electric starter are cut out and the starting battery is placed on "trickle" charge.

Among other smaller engines on this stand there are a 36 B.H.P. twin-cylinder marine oil engine and a 5 B.H.P. single-cylinder unit, while a direct-current generating set is typified by a 12 B.H.P. engine driving an 8-kW General Electric Company's generator mounted on a common baseplate. A new

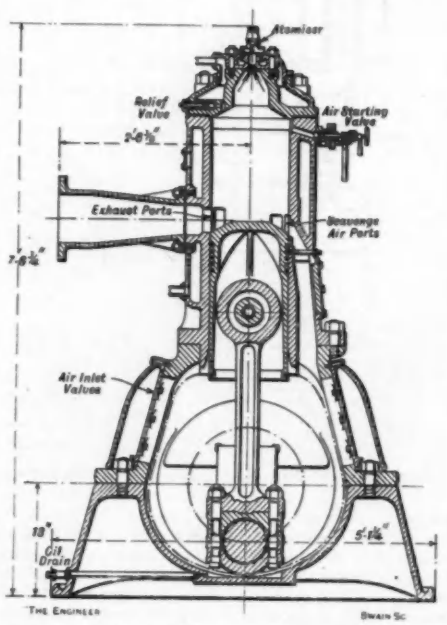


Fig. 17—35 B.H.P. Oil Engine—Petter

feature of the 5 B.H.P. universal type of hopper-cooled engine, which has a bore of 4¾in., a stroke of 4½in., and a normal speed of 600 r.p.m., is the special joint ring for the cylinder head—see Fig. 15—which, by altering the compression, enables the same engine to be worked on either paraffin or petrol at the user's option. Several smaller engines from 1½ to 8 B.H.P. output demonstrate typical standard Petter electric lighting and air compressing plants.

R. M. Catterson Smith.

On the stand of R. M. Catterson Smith, of Lacland-place, 429B, King's road, Chelsea, S.W. 10, there is an electric furnace for pottery and other work requiring a temperature of 1300 deg. Cent. The furnace is lined with high-grade sillimanite refractory, and the heater rods are placed in recesses in the lining. All the heating elements are independent units, and may be replaced separately. A rheostat limits the power input as desired, and controls the speed of heating. Examples of the firm's laboratory furnaces of simple and cheap design are exhibited. These furnaces are made in two distinct types—wire-wound furnaces for a maximum temperature of 1000 deg. Cent., and resistor rod type furnaces for temperatures up to 1300 deg. Cent. They are made in several standard sizes and are said to have a long life and to be very economical to run. Other exhibits consist of refractory linings and insulators, designed mainly to fit the firm's standard furnaces, but there are also other designs for special work. A new automatic temperature control apparatus and temperature indicators with a limiting scale are also shown.

Dennis Bros., Ltd.

The exhibits on the stand of Dennis Brothers, Ltd., of Guildford, at the Fair are confined to petrol-driven lawn mowers, the construction of which presents several interesting features from a mechanical engineer's point of view. We illustrate one of these machines in Fig. 18, while Fig. 19 represents the principal part of the power transmission gear.

In this new model of mower there is utilised a substantial 4½ horse-power engine, in place of the original motor-cycle engine, which is capable of continuous daily service. It is of the four-stroke type, with enclosed valve stems and tappets. This type of engine is much more silent in operation, and capable of running at a lower speed than the two-stroke type. A high-tension gear-driven magneto is fitted, mounted on a special platform on the crank case, from which it is readily detachable. Other new features include a more powerful engine with very large bearings—the main bearings are 1½in. diameter—a crank shaft made from a solid steel

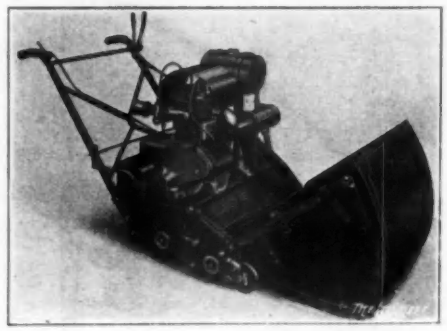


Fig. 18—Lawn Mower—Dennis

stamping, a cast iron piston, and force-feed lubrication. The oil supply for the engine is contained in a well, integral with the crank case, and of a capacity sufficient for two full days' working. The oil is delivered under pressure by a positive submerged pump, driven from the engine, which requires no attention whatever. A dip-rod projecting from the engine can be easily and quickly detached from the main framing, and is fitted with a two-jet carburetter controlled by a single lever. An air cleaner is arranged on the intake. The engine is air-cooled by means of a fan. The petrol tank has a capacity of 1½ gallons. The main roller of the mower is divided into three sections longitudinally, which are interconnected by differential gear, so that the machine can be easily manœuvred round corners.

The transmission gear—shown in Fig. 19—comprises two fabric-lined cone clutches, connected together by an inverted tooth chain, which drive the cutter and the main roller separately through other chains. These driving chains are steadied by jockey wheels running on ball bearings. All the various

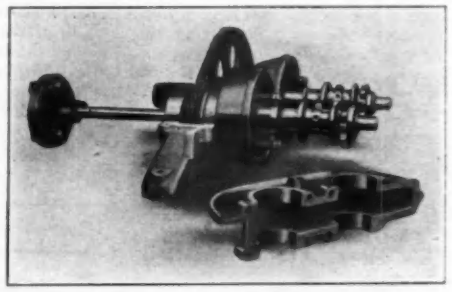


Fig. 19—Transmission Gear—Dennis

parts which may require attention are easily accessible and the machine can be used as a simple grass roller by declutching the cutter.

The British Electrical and Allied Manufacturers' Association.

An example of what can be done by co-operation for the good of an industry is demonstrated by the large electrical restaurant which has been provided at the Fair. The heating and cooking section of the British Electrical and Allied Manufacturers' Association, which is responsible for the collective loan of equipment that has been installed, does not wish names to be associated with the individual appliances. Apart from the restaurant equipment, over fifty manufacturers are exhibiting electric cooking apparatus and appliances. For the kitchen equipment conne ted with the restaurant a 150 kW, 440-volt, three-phase, four-wire transformer has been installed, and in most cases individual appliances are supplied from one-phase at a pressure of approximately 250 volts, the appliances being suitably balanced on the three separate phases of the transformer. The boiling table is, however, wired for a three-phase supply, and in this case the elements are balanced. The large roasting oven is capable of cooking from 250 lb. to 300 lb. of meat at one filling, and is fitted with a lagged shelf which enables the oven to be

split into two sections, each of which is separately controlled and independently heated, an arrangement which permits of the greatest economy in operation. The cooking space is 48½in. high by 30½in. wide and 30½in. deep. The maximum loading is 14 kW. There is also a cabinet roasting oven having an internal working space 48in. high by 24in. wide and 24in. deep, the maximum loading being 12 kW. Two steaming ovens are provided for cooking fish and vegetables, the heating elements of which are controlled by three heat switches. The maximum loading of each oven is 5 kW. There is a boiling table with a number of boiling plates upon which

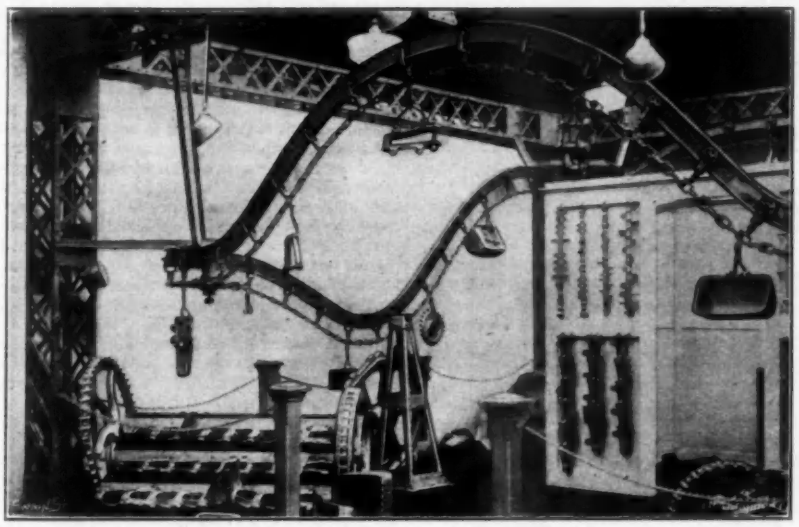


FIG. 20—CHAIN-BELT CONVEYOR—EWART

various cooking operations can be performed. Each boiling plate is controlled by three heat switches mounted on the front of the table, the maximum loading being 27 kW. Four hot cupboards are provided, three having a maximum loading of 3½ kW and one of 6 kW. There are also two Bain Maries, one having a loading of 8 kW and the other 12 kW, and both are controlled by three heat switches. Besides the roasting and steaming ovens, there is a double oven cooker and an impressive installation of cooker control switchgear. This is the first time in the history of the British Industries Fair that the main restaurant has been electrified. The restaurant is now capable of providing luncheons for 1000 people and teas for 2000 people.

EWART CHAINBELT COMPANY, LTD.

The most striking exhibit on the stand of the Ewart Chainbelt Company, Ltd., of Colombs-street, Derby, is a conveyor which winds round the sides of

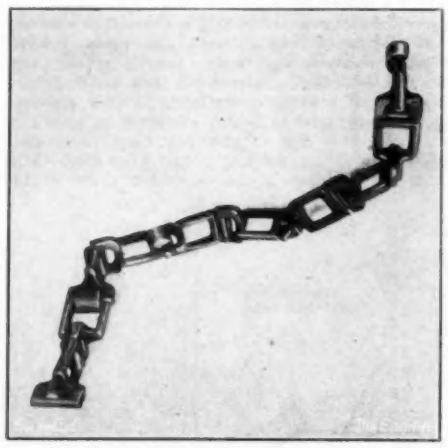


FIG. 21—VALE BIFLEX CHAIN—EWART

the stand as is illustrated in Fig. 20. As will be seen, it has been deliberately so arranged that it takes a number of awkward turns, in both horizontal and vertical planes to demonstrate the flexibility of the Vale Biflex chain. The construction of this chain, which is of the malleable cast type, is plainly shown in Fig. 21. The chain is hung from the bottom flange of an I joist by wheeled hangers, and on to it there are hooked a variety of objects to show its adaptabilty for shop or warehouse service. On this stand there is also a selection of malleable chains, wheels, and buckets.

HEWITTIC ELECTRIC COMPANY, LTD.

As on previous occasions the Hewittic Electric Company, Ltd., of Hersham, Walton-on-Thames, has erected a mercury vapour rectifier sub-station for supplying direct current for lighting and power purposes. The plant, which is shown in Fig. 22, is designed to operate off the Birmingham 5000-volt, three-phase, 25-cycle supply, and to deliver direct current to a 460–230-volt three-wire system. The plant is composed of two 92-kilowatt sets, each comprising two rectifier bulbs, a transformer, and an induction regulator. From the diagram of connections—Fig. 23—it will be perceived that each of the sets is arranged to feed on one side of the middle wire, so as to deal with any out of balance load. The rectifiers are enclosed in sheet steel and wire mesh cubicles, comprising bulb chambers with ventilating fans under the bulbs and control switchgear and instrument panels. For each rectifier bulb there is a circuit breaker and knife switch controlling the direct-current output and an oil switch and fuse controlling the low-tension alternating-current supply. Each bulb can therefore run or be isolated independently from the remainder of the equipment. Direct current instruments are mounted on the panels, as shown in Fig. 22. Whilst each pair of bulbs fed from one transformer feeds one side of the mid-wire, it is possible by changing the connections to the rectifier bus-bars to arrange for one of the two bulbs of one bank to feed the positive side and the other the negative side of the three-wire system. Thus, whilst the plant is arranged in two separate equipments in series feeding the positive and negative sides of the three-wire system, each equipment can readily be arranged to feed both sides of the middle wire.

The transformers which were built by the Hackbridge Electric Construction Company, are of the oil-immersed, naturally cooled, core type, with a delta primary and hexaphase double-star secondary. Between each transformer and the rectifier bulbs, there is a six-phase induction regulator, which controls the voltage of the low-tension alternating-current supply to the rectifier bulbs, and thus regulates the direct-current voltage. The regulators were manufactured by Switchgear and Cowan's, Ltd. They are of the oil-immersed type, and are designed to give a 13 per cent. voltage range on the direct-current side, *i.e.*, a 6½ per cent. positive and negative boost. Each regulator is operated by a motor controlled on the remote system. Relays connected on each side of the middle wire govern the operation of the regulators, which maintain the direct-current pressure at the required value at all loads, notwithstanding normal fluctuations on the incoming E.H.T. supply. Each regulator is also provided with a load limiting relay which keeps the load on the rectifier within proper limits when the equipments are working in parallel with other plant. For controlling the primary supply to each transformer, there is a triple-pole E.H.T. switch, which is the only switch required for the normal control of the plant, all other switchgear on the rectifier cubicles being left on and are only employed for isolating purposes. The principle of the plant is extremely simple, for after the pressure has been reduced in the main transformers the current is passed through the rectifier bulbs which act as one-way valves and give a continuous output at the desired voltage. The sub-station is typical of the rectifier sub-stations employed for lighting and power purposes in various parts of the country, and those who are interested in this form of converting plant should not fail to pay a visit to the sub-station when at the Fair.

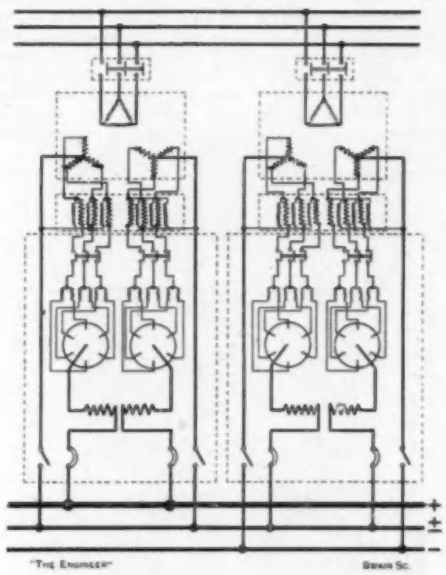


FIG. 23—RECTIFIER CONNECTIONS—HEWITTIC

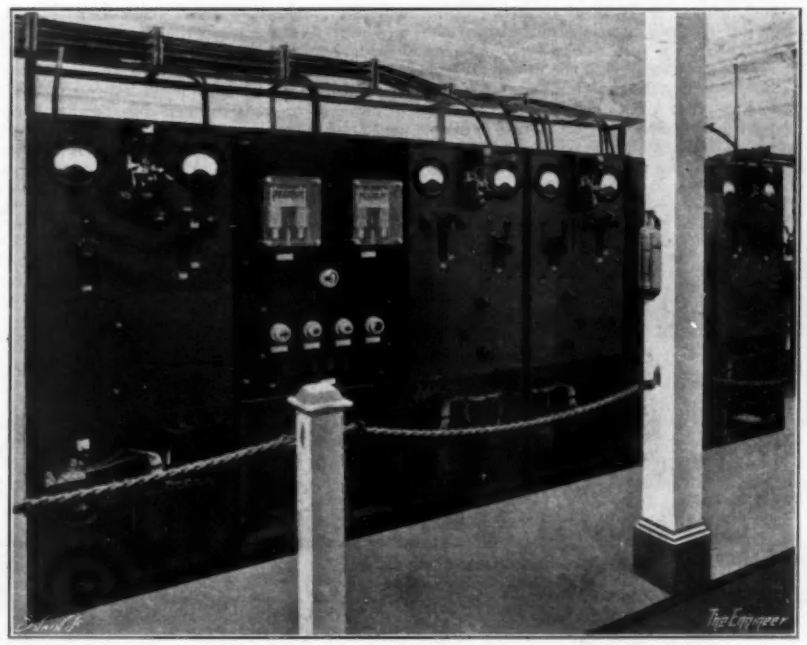


FIG. 22—600-kW SUB-STATION—HEWITTIC

ROYLES LTD.

Many of the exhibits on the stand of Royles Ltd., Irlam, Manchester, such as steam fittings, Row's calorifiers, and so forth, are so familiar to our readers as to need no description; but the Chloronol water sterilisation plant, of which we give an illustration in Fig. 24, is comparatively novel. It depends for its action, as will be guessed from the name, on the addition of chlorine to water for the sterilisation of organic impurities.

It is unnecessary here to enlarge upon the prin-

ciples and merits of chlorination, but a brief description of the apparatus may be of interest.

In arranging the final design of the apparatus it was felt that the grouping of all the parts so as to form a compact whole was desirable. Accordingly, as shown in the illustration—Fig. 24—a glass fronted cabinet measuring approximately 2ft. × 3ft. is standardised. This is provided with two hinged doors in the lower portion to allow easy access to the stop valves and microvalve, whilst the upper portion is fixed so as to prevent accidental damage to the glass work. It is thus possible to observe the entire working of the apparatus, as the measuring and absorption devices are located side by side, in full view of anyone carrying out adjustments which may be necessary according to the degree of chlorination required. Every instrument is calibrated for the particular duty it is designed to meet, and once set for this duty it will continue to function indefinitely as long as chlorine and water are supplied to the plant.

Chlorine is supplied from a cylinder of liquid chlorine,

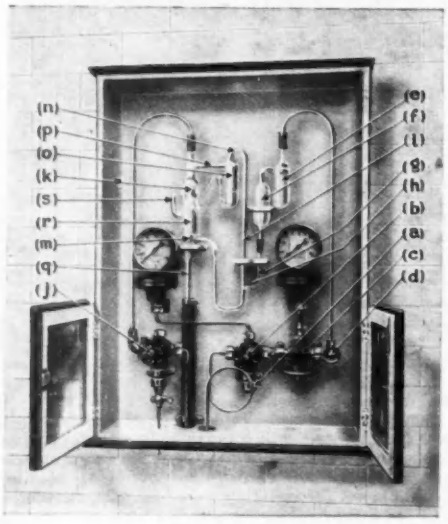


FIG. 24—CHLORONOL PLANT—ROYLES

and passing by way of a special combined filter *a* and control valve *b*, reducing valve *c* and finally a microvalve *d*, enters the apparatus at the seal *e*, and passing through *f* emerges from the tube *g* at the point *h*. Water, from any convenient supply, is connected to a similar combined filter and control valve *j*, whence it passes directly to the absorber chamber *k*. This chamber is designed to provide a fine mist-like spray across the whole of the interior of the absorber. The chlorine ascends the tube *l*, raising water supplied from the bulb *m*. At *n* the aqueous chlorine and water separate, the water falling into the graduated syphon vessel *o* and the chlorine passing along the tube *p* to the absorber *k*. The chlorine is rapidly absorbed in the constant stream of water, the solution of chlorine flowing away to the main conveying the filtered water to be sterilised through a connection from tube *q*. As the graduated syphon vessel *o* fills with chlorine solution to the level of the syphon the solution flows into the vessel *r* and there mingles with the chlorine solution which flows down the tube *q* to the main. The rapid absorption of chlorine tends to cause a partial vacuum in the vessel *r*, but the air leak tube *s* enables sufficient air to enter the apparatus to maintain gaseous equilibrium.

It will be seen that in this apparatus there are constants which ensure a predetermined, definite and regular supply of chlorine to the water undergoing chlorination. The chlorine is fed to the plant at constant pressure through the medium of the reducing valve *c*, its volume being regulated by the micro-valve *d* and the aperture *n*. The diameter and effective height of the uplift tube *l* taken in conjunction with the pressure at which chlorine enters at *h* determine the ratio of water raised to the syphon vessel to the volume of chlorine utilised in effecting this lift, hence it follows that the amount of chlorine as solution delivered to the water to be chlorinated depends upon the number of operations of the syphon per unit of time. On this stand there are, also, some small, steam-heated distilling plants, suitable for hospitals, laboratories, &c., with capacities of from 3 to 18 gallons an hour, and some electrically heated radiators, in which the radiating surface is composed of vertical groups of Row tubes.

STEWARTS AND LLOYDS, LTD.

The most novel exhibit on the stand of Stewarts and Lloyds, Ltd., 41, Oswald-street, Glasgow, is the Craggs-Plummer adjustable steel pit prop, illustrated

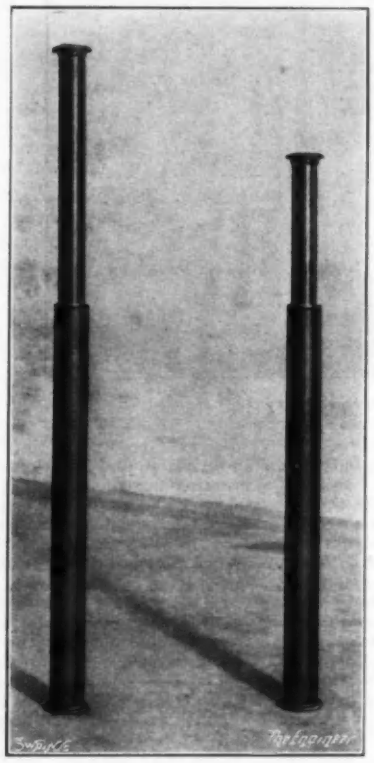


FIG. 25—STEEL PIT PROPS—STEWARTS AND LLOYDS

by Fig. 25, of which a modified design is shown. It consists essentially of two parts—a bottom tube which acts as a container, holding dirt or coal slack; and a top tube carrying a nozzle at one end, both seamless and made from high-tensile steel. A foot and cap are provided and are designed to give the maximum bearing area with lightness and rigidity. In order to prevent the cap digging into the roof bar while being hammered into position, it is formed with a rounded edge. The foot has a circular recess to avoid all possibility of slip. The cap, foot and nozzle pieces are stampings of mild steel, and are electrically welded to the tubes.

In operation the bottom tube is filled to within a few inches of the top with coal slack or dirt, and the top tube is placed in position. The prop is then hammered into place, and as the load comes on to the prop the nozzle is forced into the dirt or slack, which is compressed and forced through and past the nozzle, the action causing it to become a fine powder which passes into the inner tube and also between the inner and outer tubes. The characteristic of the prop—*i.e.*, the subsidence obtained with a given load—is determined largely by the shape and dimensions of the nozzle. The object of causing some of the dirt to pass into the space between the two tubes is to prevent the top tube being pulled out without the bottom, shown in sketches, Fig. 26. The powdered dirt between the inner and outer tubes prevents movement tending to pull the two tubes apart. When the prop has been removed all that is necessary to part the two tubes is to reverse the prop, allowing the sleeve to drop out of position, when the powdered dirt runs out, thus freeing the two tubes. The props are adjustable, and may be used at a coal face several inches less in height than the given effective length of the prop.

Another novel exhibit on this stand is a selection of copper-covered tubular steel bus-bars for electrical switchboards. The idea of these bus-bars is to produce a form in which the current is carried by copper, while mechanical strength is supplied by the interior steel tube, so that the spacing of the supports may be extended, and more accommodation be provided for intermediate connections. The inner steel tube is of the cold, solid-drawn type, and is thoroughly freed from scale before the outer sheath of electrolytic copper is drawn on. The two metals are in thorough contact throughout their length, and the steel consequently serves some purpose in conducting the current.

These tubes are made in a number of sizes with external diameters of from ¼in. up to 4in., and with copper sheathings having a minimum thickness of from 0·048in. up to 0·060in. The smaller sizes have a standard length of 16ft., and those above 2in. in diameter a length of 20ft.

HADFIELDS, LTD.

An important feature of the exhibit of Hadfields, Ltd., East Hecla Works, Sheffield, is the demonstration of heat-resisting and corrosion-resisting steels

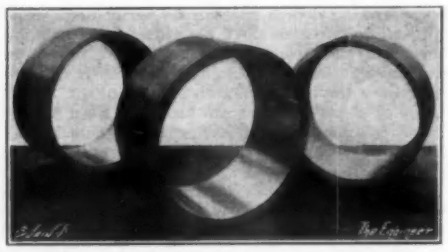


FIG. 27—STEEL RETAINING RINGS—HADFIELDS

These materials combine high resistance to heat, both as regards scaling and strength with properties usually associated with steel, such as tenacity, ductility, malleability, machinability. Their range of utility is constantly growing, and examples are shown of a large high-pressure vessel, rotor and valve forgings, hot drawn tubes and a variety of castings for all classes of furnace uses, conveyors, retorts, muffles, case-hardening boxes, hearth plates, supports, carriers, and other appliances utilised in a multiplicity of heating operations. A new development, demonstrated as heater elements in a furnace operating at 1150 deg. to 1200 deg. Cent. is an alloy capable of resisting scaling up to 1200 deg. Cent. Its high electrical resistance is of the order of 140 microhms per cubic centimetre for the range 20 deg. to 200 deg. Cent. Hadfields are putting forward improved steels to meet the increasing higher temperatures and pressures now coming into use in steam plant, and where the main problem is ability to sustain stresses at advanced temperatures without other special considerations such as corrosion or oxidisation. With the advancement of the severity of conditions obtaining in power plant the use of ordinary steels

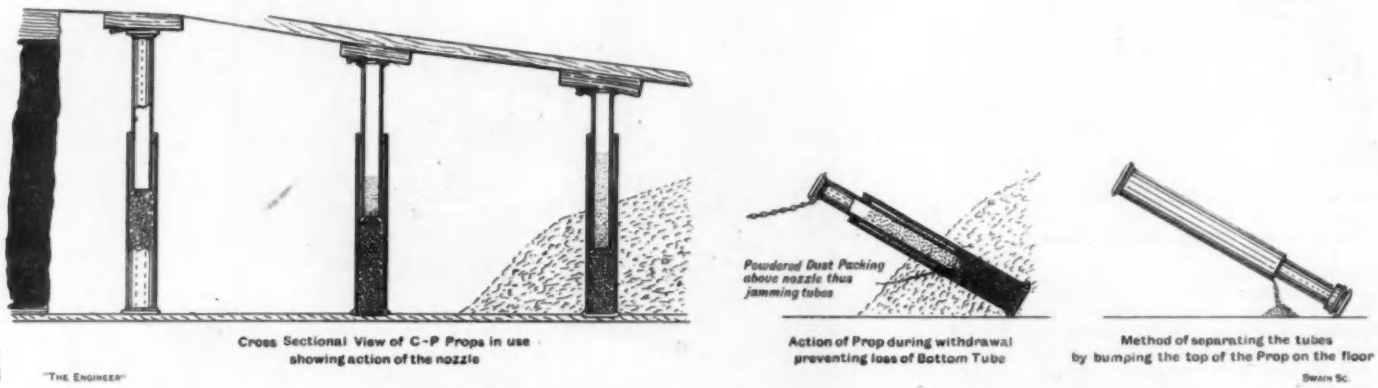

Cross Sectional View of C-P Props in use showing action of the nozzle
"THE ENGINEER"
Powdered Dust Packing above nozzle thus jamming tubes
Action of Prop during withdrawal preventing loss of Bottom Tube
Method of separating the tubes by bumping the top of the Prop on the floor
SWAIN Sc.

FIG. 26—STEEL PIT PROPS—STEWARTS AND LLOYDS

is attended with some risk, and the life of such materials is considerably reduced, whereas the improved steels remove these disabilities. These steels have two to three times the limiting creep stress at 1000 deg. Fah.—540 deg. Cent.—of a 0·4 per cent. carbon steel. The "Era CR" steel, represented by a display of cold drawn tubes and deep pressings, is specially characterised by its resistance to corrosion. These steels combine high chemical resistance with such mechanical strength and ductility as to confer upon them advantages over other materials at present in use in industrial plant in which strong corrosive influences are present. The chemical agents in which they are resistant cover a wide range, including acids, alkalies, many corrosive salts and sea water.

A special steel for turbine bladings, both for impulse and reaction turbines, is exhibited. After exhaustive trials under the severe conditions associated with high superheats and impure steam, this steel, known as "Hecla ATV" has been adopted by many turbine builders, and turbines with an aggregate of upward of 2 million horse-power have been equipped. A

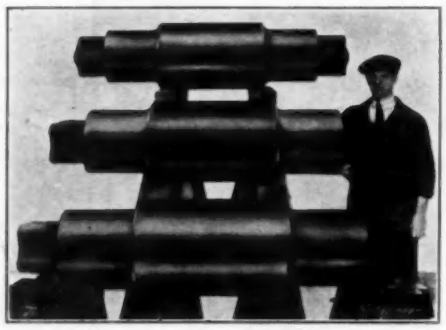


FIG. 28—BREAKING-DOWN ROLLS—HADFIELDS

retaining ring of a turbo-electric generator is exhibited in a further new steel—"Resista HY"—which is non-magnetic, of high tenacity and yet machinable. This constitutes a distinct advance since the non-magnetic materials available have previously been difficult to machine, and generally of low yield point. The mechanical properties in this case are: Tenacity, 50 tons per square inch; yield point, 35–40 tons per square inch, and elongation, 30 to 35 per cent.

Examples of "Hecla 18" hollow mining drill steel show the improvement in the surface of the hole formed by the usual sand core and that produced by the metal cored process. It was found, under certain conditions, that the rough surface of sand-cored holes resulted in a fruitful source of corrosion pits which ultimately started fatigue cracks and caused the drills to break when in use. By the Hadfield patented metal-cored process, this has been remedied and hollow drill steel can now be made with a hole that is quite smooth from end to end of the bar.

THE RAPID MAGNETTING MACHINE COMPANY, LTD.

One of the exhibits of the Rapid Magnetting Machine Company, of Magnet Works, Lombard-street, Birmingham, is a foundry-sand plant for dealing with dry sand and capable of handling

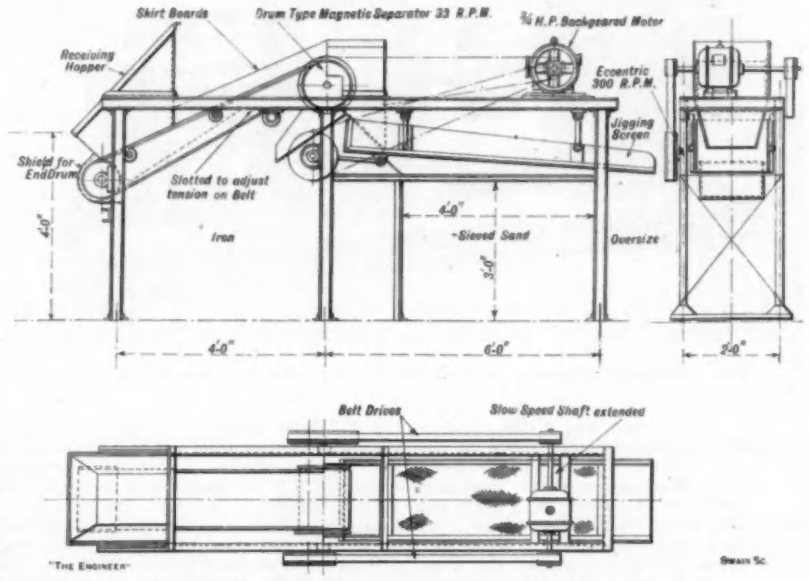


FIG. 29—FOUNDRY-SAND PLANT—RAPID MAGNETTING

from 3 to 4 tons of sand per hour. The plant, which is shown in Fig. 29, consists of a channel and angle structural framework with cross-bracing stays, supporting a jig-shaken screen at one end and a magnetic separator of the belt conveyor type at the other end. At the intake end there is a companion pulley for the belt conveyor, and above this pulley there is a receiving hopper for the material to be treated. For the support of the upper and lower sides of the conveyor belt idler pulleys are provided, and at the discharge end of the conveyor the magnetic separator pulley is fitted above the structural framework. After travelling up on the belt, the material from the hopper passes over the magnetic pulley and the magnetic material is carried beneath the pulley and is discharged down its own chute into the first division beneath the equipment. The remaining non-magnetic material falls vertically direct on to the jig-shaken screen. During its passage down this screen, all the fine sand is sifted out and falls into a compartment beneath. Finally, the non-magnetic oversize material is discharged at the end of the screen beyond the framework. The screen is suspended on links, pins and brackets, and is shaken by self-aligning excentric with a cover and mounted on countershaft driven by belting from an electric motor fixed at the top of the framework. From the same motor the belt conveyor portion is also driven by means of pulleys and belting on the magnetic separator shaft. The Rapid Magnetting Machine Company also exhibits five examples of its magnetic drum and pulley-type separators, two types of chute separators, a magnetic clutch, and two types of lifting magnets.

J. ACKWORTHIE, LTD.

Among the stands exhibiting small machine tools, that of John Ackworthie, of 51, Coleshill-street, Birmingham, is noteworthy. On it there is exhibited a wide variety of such appliances as machine vices, chucks, tapping and drilling attachments, turrets and taps and dies. Among these there are

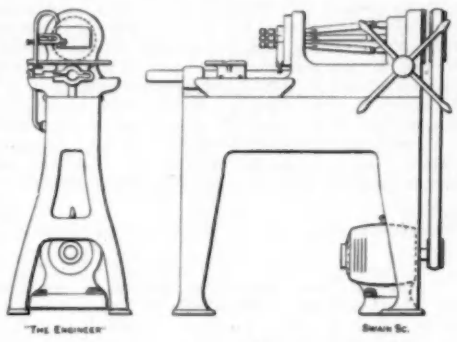


FIG. 30—DRILLING MACHINE—ACKWORTHIE

the six-spindle horizontal drilling machine which we illustrate in Fig. 30, which has the advantage when drilling deep holes, that the swarf comes away from the drilling point more readily than when drilling vertically downward. Incidentally, there is not the weight of the table and job to lift during the drilling process, so that the feed is very sensitive. The drilling spindles, it will be seen, are driven by shafts with flexible couplings at each end, and are carried by a plate in a separate head, which might be described as a jig, as it is made to suit the job in hand. In the case of the larger machines, ball bearings are provided to take up the thrust of the feed on the drill, while the smaller machines have steel and fibre washers for the same purpose. The spindles can be grouped within a circle of 5½in. diameter, and their diameter depends upon the closeness together of the holes to be drilled. Thus, the smallest spindle enables holes ¼in. in diameter to be drilled ⅞in. apart, while a ¾in. spindle is suitable for ¼in. holes ¾in. apart. Naturally the largest possible spindle for the work in hand should be utilised. The standard machine has a total movement of the table of 7in. and has an automatic traverse of 3in.

THE CHLORIDE ELECTRICAL STORAGE COMPANY, LTD.

Storage batteries for a variety of purposes are exhibited by the Chloride Electrical Storage Company, Ltd., of Clifton Junction, Manchester, including batteries for stationary installations, as

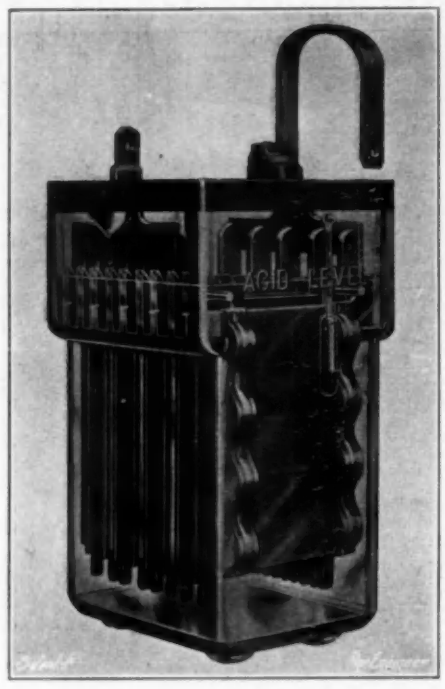


FIG. 31—STORAGE CELL—CHLORIDE

shown in Fig. 31. This particular type of cell is supplied fully charged, and the lid is sealed in order to prevent leakage of the acid during transit. Stationary batteries are also shown for central station use, for the emergency lighting of theatres, cinemas, shops and public buildings. There is a good display of high-tension and low-tension wireless batteries and batteries for talking film installations and sound

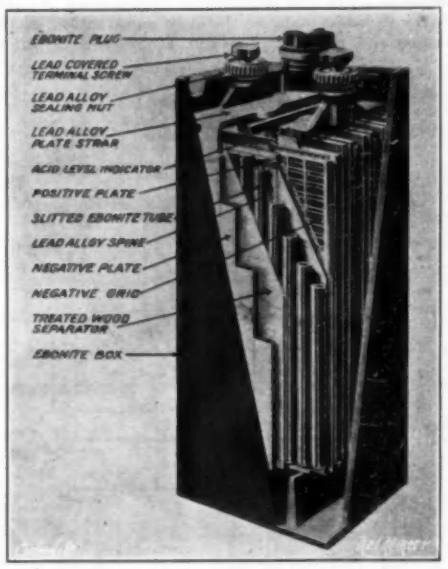


FIG. 32—IRONCLAD BATTERY—CHLORIDE

projector systems, and a range of unspillable cells for portable wireless sets and for miners' hand lamps. Exide ironclad batteries—as shown in Fig. 32—for marine work and for traction, and Lux batteries for train lighting and the company's trickle charger are also among the other exhibits on this stand.

PARKER, WINDER AND ACHURCH, LTD.

On the stand of Parker, Winder and Achurch, Ltd., Broad-street, Birmingham, there are some examples of a new form of industrial oil burner, with which, it is claimed, it is possible to burn the heaviest grades of oil, including residues and tank bottoms in refineries. These burners are, it is said, efficiently atomising residue of 1·044 specific gravity containing 40 per cent. of solids in suspension. One of them is exhibited fitted to a small metal-melting furnace, by British Reverberatory Furnaces, Ltd., of 82, Victoria-street, Westminster, which is illustrated in Figs. 33 and 34.

The makers call the burner itself a "gun" and

claim that its outstanding feature is the fact that it includes only one moving part. This part is a little impeller, at the front end of the gun, which is rotated by the primary air used for the atomisation of the oil impinging on its blades. The oil, under a comparatively low pressure, passes up the centre of the burner body in a pipe, at the end of which there is a mushroom valve. The stem of the valve extends back through the pipe to the rear of the burner and is there provided with a fine screwed adjustment.

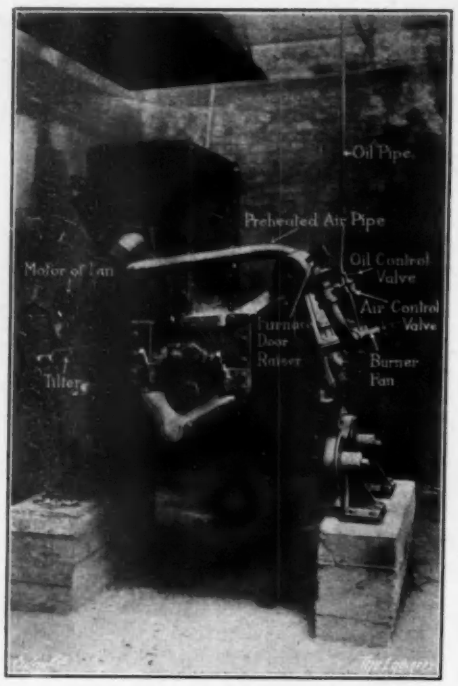


FIG. 33—OIL-FIRED FURNACE

so that the flow of oil can be regulated. The oil emerging from the narrow annulus of the valve is projected into the impeller, or spinner, already mentioned, at its smaller diameter and forms a thin film round its periphrey. It is fed forward by centrifugal force and the conical form of the spinner, and is projected into the mouth of the burner from a very fine edge. The consequence is that the oil is most effectively atomised, by the combined action of the spinner and the primary air. Inside the mouth of

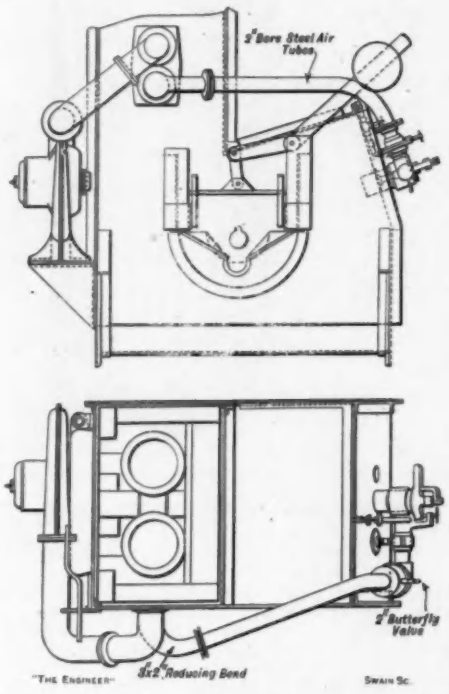


FIG. 34—OIL-FIRED FURNACE

the burner there is a replaceable conical bushing, which determines the size of the flame, according to its taper. It is noteworthy that the bearings of the spinner are lubricated by the oil which is being atomised, so that the wear of this only moving part is negligible. The valve and spinner can easily be removed from the casing for cleaning, as it is necessary to slack off only one clamping screw. The casing remains in position in front of the fire-box, so that its proper direction is always assured. It is claimed for these burners that they produce an unusually short flame, and one of great turbulence, which is specially suitable for use in small fire-boxes. They are made in three sizes, with capacities of from 1 to 15, 5 to 50 and 50 to 135 gallons per hour. The makers also supply various accessories, such as blowers, pumps, oil strainers and valves.

The furnace itself with which this burner is associated is intended to take the place of the usual pit and crucibles for the melting of yellow metals and is of the tilting type, as is plainly indicated in Fig. 33. The charge is dropped into the trunk, which can be seen extending upward at the back of the furnace, which also serves for an outlet for the products of combustion. The burner can be seen at the front and blows its flame downward on to the bath of metal which accumulates in the bottom of the furnace from the melting of the charge. The successive sections of the furnace are so proportioned that the velocity of the gases over the molten bath is comparatively slow, while in passing through the charge they travel at a high speed. The arrangement of the burner is also such that a reducing, oxydising, or neutral flame can be produced according to the characteristics of the metal being melted. In the outlet flue there are arranged two carborundum tubes, lined with steel to insure against mechanical injury, in which the air for the burner is pre-heated.

As to the building construction of these furnaces, they seem to be very convenient for the renewals which are inevitable with all refractories. The whole contrivance is built up of standardised blocks, which merely need "flushing" over with fire-clay before they are put in place. The back of the furnace casing is attached by bolts, so that it is an easy matter to get at the lining for repairs, and the bridge separating the fire-box from the uptake, which is, naturally, most subject to deterioration, has been so devised that new blocks can be quickly put in position without disturbing the remainder of the setting. We are, in fact, told that the whole of the brickwork can be replaced by a labourer in two hours.

These furnaces are made with basins having capacities of from 50 lb. up to 2 tons of metal, and will, it is said, melt 100 lb. of yellow metal, generally speaking, at a cost of 3d. for fuel oil, while at least sixteen melts of 300 lb. can be completed every day.

THE ELECTRICAL POWER ENGINEERING COMPANY, LTD.

A range of direct-current motors is being shown by the Electrical Power Engineering Company (Birmingham), Ltd., of Ward End, Birmingham. The company is also exhibiting alternating-current motors with outputs and all the main dimensions corresponding to those of the direct-current machines, irrespective of whether the former are single, two, or three-phase squirrel-cage motors or two or three-phase slip-ring machines designed for standard speeds. The rotors of the squirrel-cage motors have aluminium bars and end rings, and are claimed to give an exceptionally high starting torque without detriment to power factor and efficiency. Both the squirrel-cage and slip-ring machines are also said to be exceptionally quiet in operation. The brush gear of the slip-ring motors is rigidly mounted on the inside of the slip-ring end cover. Brush lifting and short-circuiting gear is not fitted on standard machines, but it can be provided if called for. Ball and roller bearings are fitted to all the motors. To meet the demand for generators for chromium, cadmium, and other plating processes, the company has introduced a range of heavy current generators, and one of these machines, coupled to a motor and forming a motor generator set, is shown in Fig. 35. For currents up to 2000 ampères the reverse-ventilated single-commutator type of machine is employed, and interpole and equaliser windings are provided when necessary, as, for instance, when it is required to reduce the pressure from, say, 10 volts to 2 volts by field regulation. This range in voltage can be obtained irrespective of whether separate or self-excitation is used. In machines designed for more than 1000 ampères a specially designed armature reduces the possibility of circulating currents in the brushes to a minimum, thus reducing the number of brushes and therefore the brush friction loss. The brush gear is of the sliding box type, and on machines designed for over 1000 ampères the brush holders are of girder section, and are firmly bolted to bus rings. A pointer indicates the correct position of the brush gear. Machines for generating 3000 ampères and over are of the dual commutator type, and are provided with a special ventilating system.

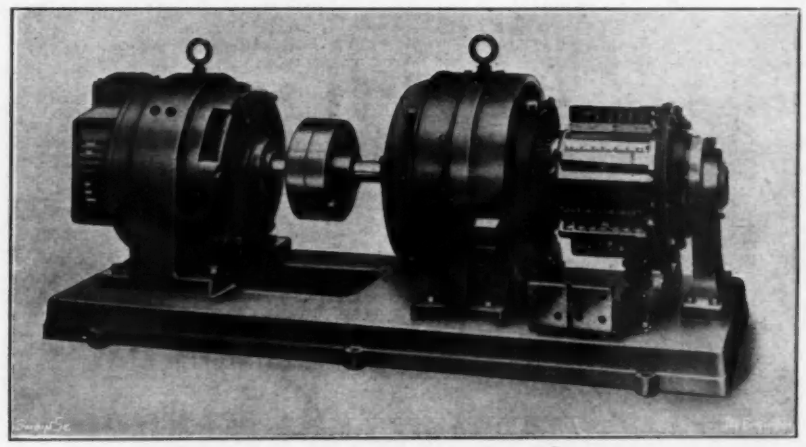


FIG. 35—HEAVY-CURRENT MOTOR GENERATOR SET—ELECTRICAL POWER

DAVEY, PAXMAN AND CO., LTD.

The exhibits of Davey, Paxman and Co., Ltd., Colchester, include a heavy oil engine of the vertical type, with four cylinders, capable of developing 265 B.H.P. at a normal speed of 333 revolutions per minute. This engine is shown running under its own power, but at quite a slow speed, in order to demonstrate its "flexibility." In Fig. III. of our Plate Supplement we show the engine on test in the makers' works. As we have described its characteristic features in past issues, it is unnecessary to enlarge upon them here. A new feature of the engine is, however, the system of forced lubrication which is shown in Fig. 36. The oil is drawn from the container by a rotary pump furnished with a pressure-regulating valve. It is passed through the oil cooler to the main distributor, from which separate supplies to the main bearings are taken off. The bottom and top end bearings of the connecting-rod are supplied through passages drilled in the crank shaft and the rod. Special oil guards are fitted to prevent oil from splashing on the bottom end of the liner. The return oil is contained in a large exterior sump, which is furnished with an oil strainer and enables the engine to be worked with a dry bed-plate. For priming the system a special hand pump with a non-return valve is provided. On the stand there are shown some full-sized sectional models of the more novel parts of the engine, and an example of the new wrought steel, sectional, hot water boiler, which the company has developed to take the place of the conventional cast iron boiler. The new boilers have the merit that their heating surfaces can be easily cleaned, while they are, naturally, comparatively light in weight, and can be worked either as plain hot water boilers or as low-pressure steam heaters.

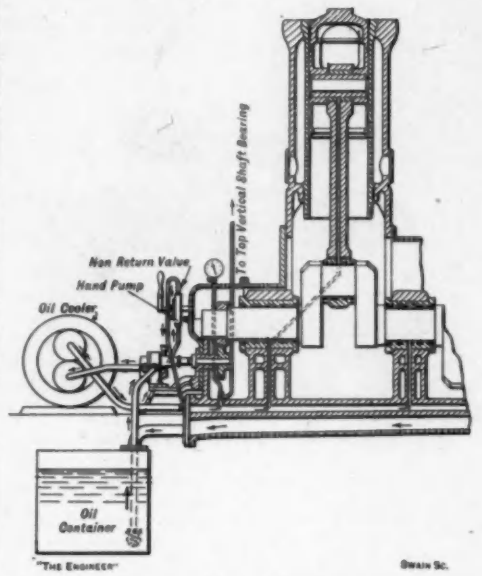


FIG. 36—OILING SYSTEM—PAXMAN